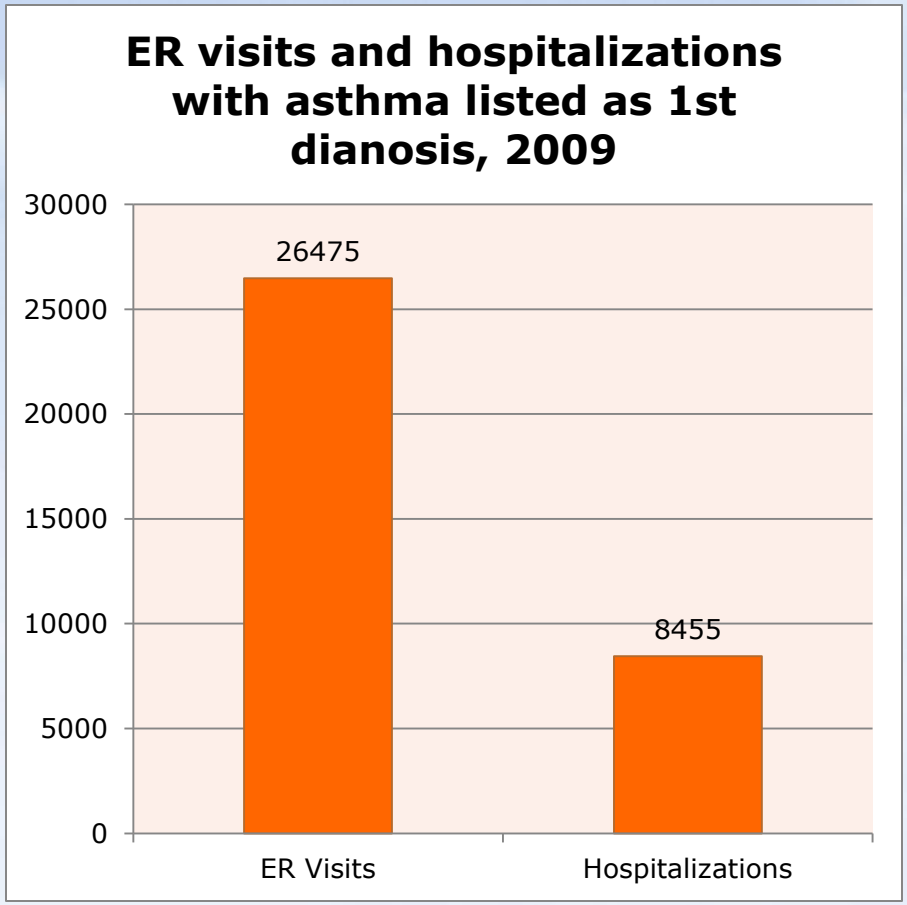
PM10 & Childhood Asthma in Maricopa County

- EPA challenge grant 2006
- The impact of air pollution on children's health: the latest medical research

Asthma in Arizona

- Asthma prevalence above national average
- Up from 11% in 2000 to 15% in 2009
- 700,000+ Arizonans have been told by their doctor they have asthma
- Ambulatory-sensitive disease: with good primary care & avoidance of triggers, ER & hospital visits can be prevented

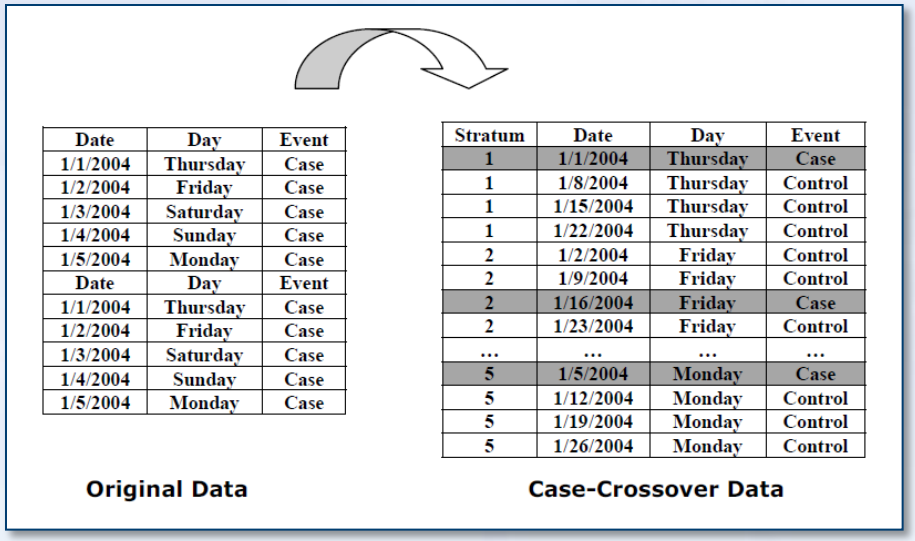
Asthma in Arizona



- AHCCCS paid 50% of all asthma ER visits, Medicare 6.7% = 56.7% public $$
- **Total cost: $44.5 million**
- AHCCCS paid 39.1% & Medicare paid 23.8% of the hospital bills = 62.9% public $$

Goals of the Study

- Exchange quality-assured hospital & ER admissions data & air quality data with partners
- Examine the correlations between data sets



Date	Day	Event
1/1/2004	Thursday	Case
1/2/2004	Friday	Case
1/3/2004	Saturday	Case
1/4/2004	Sunday	Case
1/5/2004	Monday	Case
Date	Day	Event
1/1/2004	Thursday	Case
1/2/2004	Friday	Case
1/3/2004	Saturday	Case
1/4/2004	Sunday	Case
1/5/2004	Monday	Case

Original Data

Stratum	Date	Day	Event
1	1/1/2004	Thursday	Case
1	1/8/2004	Thursday	Control
1	1/15/2004	Thursday	Control
1	1/22/2004	Thursday	Control
2	1/2/2004	Friday	Control
2	1/9/2004	Friday	Control
2	1/16/2004	Friday	Case
2	1/23/2004	Friday	Control
…	…	…	…
5	1/5/2004	Monday	Case
5	1/12/2004	Monday	Control
5	1/19/2004	Monday	Control
5	1/26/2004	Monday	Control

Case-Crossover Data

Photo courtesy of azdeq.gov

Goals of the Study, cont.

- Develop a predictive model for asthma episodes & air quality thresholds in Maricopa County

- Investigate possibility of creating an alert system on the potential health effects of poor air

Partners

- ADEQ – provided air monitor data
- ADHS – provided data on ER visits & hospitalizations for asthma as a primary diagnosis
- ASU – analyzed the data & provided predictive modeling for weather & pollution

Study Design

- Area: 168 census tracts in Metro Phoenix
- Boundary: Dunlap Rd., 52nd St., Eliot Rd & 75th Ave.
- Each census tract in area was located within 5 miles of a permanent PM_{10} monitor
- Mapped PM_{10} concentrations via monitoring & modeling

Central Phoenix Continuous PM10 Monitoring Sites

Monitors

Permanent:

CP - Central Phoenix
DC - Durango Complex
WF - West 43rd Avenue
WP - West Phoenix
GR – Greenwood
SP – South Phoenix
SS1 - Supersite

Temporary:

MRV - Maryvale
VGC - Valley Garden Center
WVR - Weaver's Auto Service
CSA - Community Service

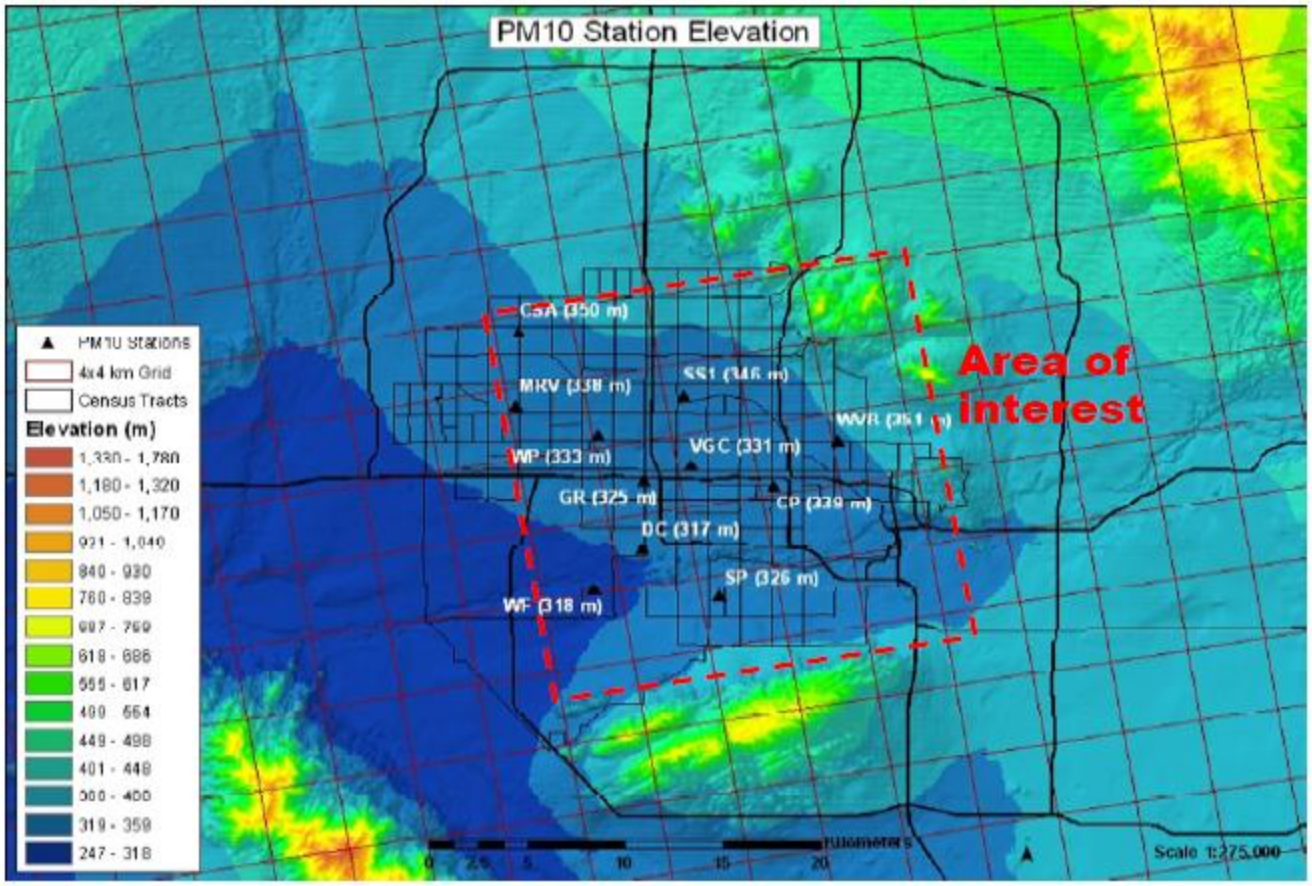


Photo courtesy of azdeq.gov

Study Design

- Analyzed 5,000+ hospitalizations & ER visits for asthma as the 1st diagnosis
- Population: children age 5-18
- Duration: 21 months, from January 1, 2005 to September 30, 2006
- Controls: reviewed 24-hour avg. PM_{10} from 1-7 days before the health event in each case
- Modeled weather & pollution predictions for potential new warning systems

Results

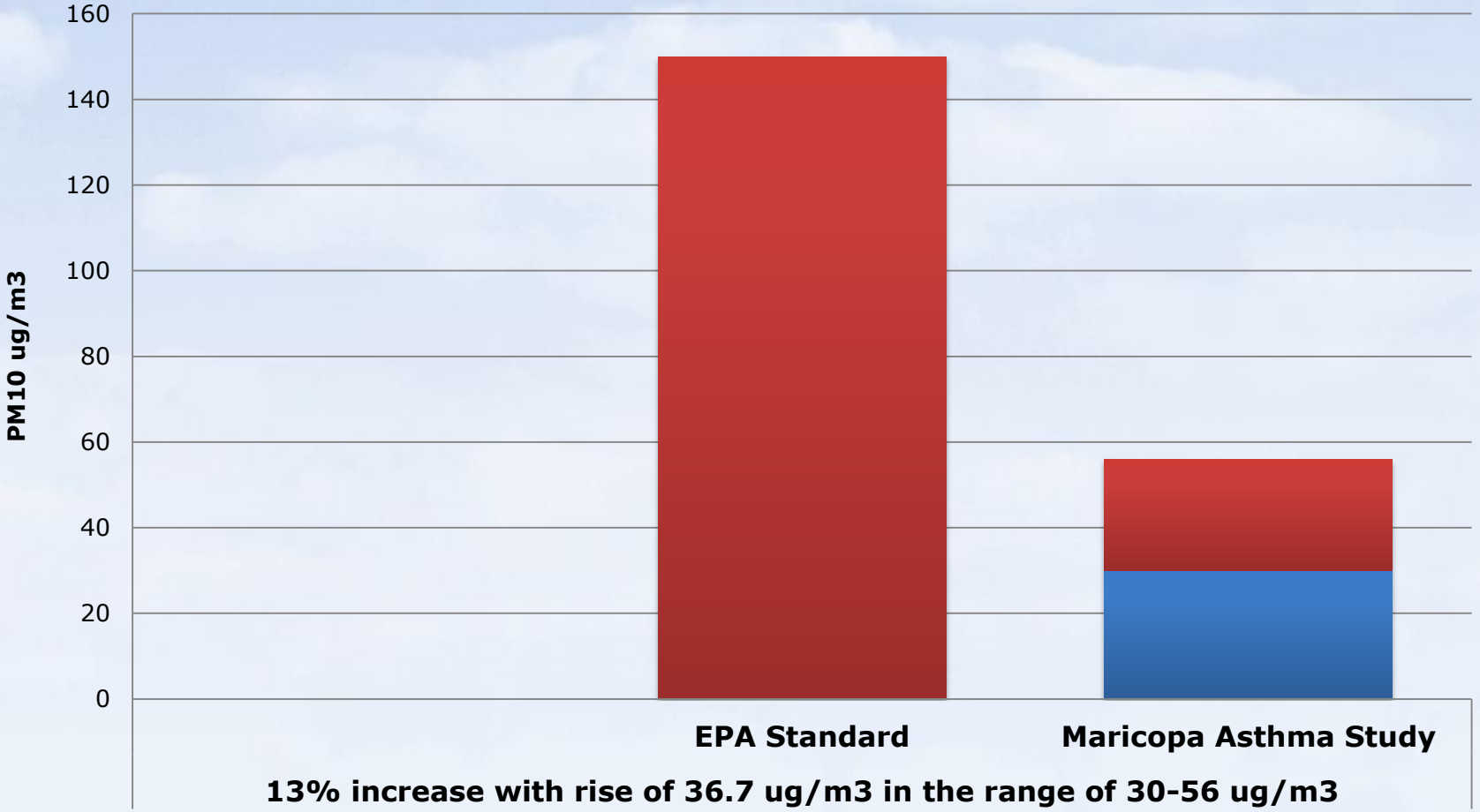
Positive correlations between elevated PM_{10} & high asthma incidence in Metro Phoenix

Photo courtesy of niehs.nih.gov

Results, cont.

- 13.7% increase in asthma events when PM_{10} rose by 36.4 µg/m3 (in range of 30-56 µg/m3)
- This is a change in the daily average PM_{10} from the 25th percentile to the 75th percentile
- Statistically significant at 95% confidence level

Asthma ER & hospital visits linked to elevated PM10



Conclusions

Photo courtesy of gnews.com

- This is a stronger effect than seen in other studies where such site-specific health and air quality data may not have been available
- Significant increase in the likelihood that children may have an asthma event with a relatively small increase in PM_{10}

Study Conclusions

- The at-risk population is greater than previously observed
- Sensitive populations need greater protections than the current systems in place
- The study design can be used to model other pollutants such as $PM_{2.5}$, ozone, or a combination of pollutants

Photo courtesy of coyoteblog.com

Research on air pollution and asthma

- $PM_{2.5}$: Utah Valley Steel Mill closed for 13 mo. & reopened (1980s)
  - 89% increase in childhood hospital admissions during months mill was open
- Ozone: 1996 Atlanta Olympic Games, city traffic curtailed for 3 weeks
  - Peak ozone fell by 28%, Medicaid claims for asthma dropped 48%

Traffic-generated air pollution

- CA: longitudinal study in 12 communities-urban, suburban & rural
  - Showed reduced lung function growth linked to PM_{10} concentration near urban highways
  - Long term exposure associated with changes in lung function in teens and adults
  - Forced respiratory volume (FEV) was lower in people who live in polluted areas

Traffic-generated pollution

- NJ & PA study of pregnant mothers who lived near highway toll plazas
  - After E-Z pass system introduced, traffic passed through tolls faster, no idling
  - Lower pollution associated with 10.8% reduced prematurity and
  - Low birthweight reduced by 11.8%

Effects of Inhaled PM:

- **Lungs**: *inflammation*, oxidative stress, alters pulmonary reflexes, reduces lung function

- **Blood vessels**: *inflammation* of lining, accelerates atherosclerosis, vasoconstriction & hypertension

Effects of Inhaled PM:

- **Heart**: abnormal rhythm, increases ischemia, exacerbates heart failure
- **Blood**: activates white blood cells, alters flow, increases coagulation, reduces oxygen saturation
- **Brain**: reduces blood flow (ischemia)

Long term effects of pollution

- Asthma incidence may be related to air pollution exposure in utero and early life
- 1st trimester exposure to PM_{10} and 2nd trimester NO_2 exposures associated with lower lung function in children age 6-11
- Ozone, $PM_{2.5}$ & CO are harmful to infants at levels below the EPA thresholds

Photo courtesy of sbcapcd.org

Maricopa County
Air Quality Department

Arizona Asthma Coalition

CLEAN AIR MAKE MORE

WALK MORE USE CFLS MORE ERRANDS MORE RIDE PUBLIC MORE CONSIDER SOLAR REDUCE WOODBURNING MORE RIDE

Do cities with bigger improvements in air quality have bigger improvements in health, measured by life expectancy?

- Studied 51 metro areas from 1980-2000

- YES: a 10 mcg/m^3 reduction in $PM_{2.5}$ is associated with 1 year increase in life expectancy

Maricopa County
Air Quality Department

DRIVE HYBRIDS MORE CONSOLIDATE ERRANDS MORE RIDE PUBLIC TRANSPORTATION MORE USE ENERGY EFFICIENT APPLIANCES MORE CARRY REUSABLE TOTE BAGS MORE CONSIDER SOLAR MORE RUN COLD WATER CYCLES MORE USE REUSABLE CONTAINERS MORE CONSERVE ELECTRICITY MORE REDUCE WOODBURNING MORE RECYCLE MORE USE ELECTRIC LAWN AND GARDEN EQUIPMENT MORE REFUEL AFTER DARK MORE RIDE THE BUS MORE WALK MORE

Policy implications

- Air pollution is recognized as a serious public health hazard
- Adverse effects on respiratory system occur at levels below the current ambient standards
- Focus control strategies on specific sources & constituents that are damaging to health

Policy implications

Photo courtesy of ehow.com

Photo courtesy of examiner.com

- Change zoning for schools & homes to increase distance from busy roadways
- Develop alert systems so at-risk people can decrease exposure on bad air days
- Study children's environmental health long-term
- Current regulations could be more stringent

Sources

- Protecting our Children: Assessing the Link Between PM_{10} Pollution and Childhood Asthma In Maricopa County. Children's Health Challenge Grant Project, December 2008. ADEQ. *www.adeq.gov/ceh/download/Exchange%20Grant%20Summary.pdf*

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- J Grigg: Air pollution and children's respiratory health – gaps in the global evidence. Clinical and Experimental Allergy 41:1072-1075. 2011.

Sources

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- CA Pope, M Ezzati & D Dockery. Fine-Particulate Air Pollution and Life Expectancy in the United States. New England Journal of Med. Jan. 22, 2009

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